ASSESSING THE COSTS OF ENVIRONMENTAL LEGISLATION

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PREFACE

This Congressional Budget Office staff working paper presents a taxonomy of definitions regarding the costs of environmental regulation. These various cost concepts are illustrated with examples based on cost estimates for legislative proposals relating to ozone attainment requirements under the Clean Air Act. The study was prepared in response to requests from the House Committee on Energy and Commerce, the majority and minority staffs of the Senate Environment and Public Works Committee and its Subcommittee on Environmental Protection, and a separate group of 34 Senators.

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SUMMARY

As the Congress moves toward reauthorizing the Clean Air Act, it is increasingly asked to consider explicitly the costs of alternative legislative proposals. In response to members' requests, Congressional support agencies have provided several detailed economic analyses of Senate and House bills to control acid rain, attain national ambient levels of ozone, and address other forms and sources of air pollution. In addition, other federal agencies and private organizations have conducted economic analyses of legislative proposals and made them available to the Congress. Taken together, these studies offer often widely differing definitions and estimates of so-called "costs of environmental regulation."

To assist the Congress in interpreting these estimates, this paper sets out a taxonomy of cost definitions and assesses their meaning and application. To illustrate these different definitions, existing government estimates of Congressional proposals to reduce ozone concentrations (for example, as found in H.R. 3054 and S. 1894) are evaluated. Although these estimates differ in scope and measurement, they all tend to reflect the first-order cost burden of regulation and rarely consider how these cost burdens are translated into the changes in prices and output that ultimately determine the impact of regulation on the overall economy. Previous estimates of the impact of pollution control spending on the macroeconomy have found that a dollar of pollution control spending is expected to result in a one- to three-dollar loss in measured national output. Estimates obtained in this report fall into this range. Thus, a $10 billion annual pollution abatement requirement is likely to reduce real national output by $10 billion to $30 billion yearly.

TYPES OF ENVIRONMENTAL REGULATORY COSTS

Most estimates of the cost of environmental regulation are based on the initial cost to pollution sources of installing certain control technology or undertaking some other specific type of reduction program. **Compliance cost** estimates such as these may be useful for identifying the initial cost burden to affected firms, but say very little about how firms might respond to this potential increase in costs. By changing inputs and outputs, increasing prices, or reducing other production costs, firms are likely to reduce their first-order impact and shift some of the burden to suppliers, workers, and consumers. **Industry-level cost** estimates, properly constructed, will tend to demonstrate how compliance costs might be translated, by the decisions of individual firms, into effects on industry performance.

Industry-specific effects or cost burdens do not, however, provide a complete picture of the aggregate effects, or **macroeconomic impacts**, on the economy as a whole. Losses in one industry may be offset, in part, by gains in another (for example, in pollution abatement industries) or within the industry itself, leaving the aggregate economy less worse off than would be suggested by the compliance or industry-level cost estimates alone. Finally, estimates of macroeconomic impact may not reveal possible changes in **social welfare**, to the extent that the estimates do not reflect the value that producers and consumers place on the economic changes resulting from environmental regulations. Moreover, these economic changes would include both measurable and nonmeasurable costs. Of course, all of these measures should be viewed as gross rather than net costs, since they do not include the increased production of such goods as pollution-abating equipment or environmental control benefits such as improved health.

OZONE ATTAINMENT PROPOSALS: A CASE STUDY OF REGULATORY COSTS

The Senate is currently considering a comprehensive set of amendments to the Clean Air Act. The House is reviewing a more limited set of revisions. Both bills would address the failure of many urban areas to achieve the national air quality standard for ozone. The existing cost analyses of Congressional proposals illustrate several of the more important characteristics of regulatory cost analyses. Virtually all estimates of costs to the private sector fall into the category of compliance costs and are predicated heavily on assumptions concerning control technologies and the cost per ton of emissions reduced. The range in existing estimates of ozone compliance costs is quite large, from a low estimate of around $4 billion per year to a high estimate of approximately $13 billion. There are many reasons for the difference, ranging from uncertainty concerning control costs as they might apply to different industrial sources to different interpretations of how the bills would be implemented.

No government agency has formally estimated the industry-level costs or small business impacts. This lack of analysis limits a full understanding of the economic effects of ozone attainment provisions. Moreover, all of the existing analyses restrict the type and scope of potential economic responses to increased control requirements, and by ignoring any attendant benefits overestimate the long-run total net social costs.

Estimates of the cost of regulation to the public sector (state, local, and federal governments) are distinctly different from the private-sector cost estimates but share some of the underlying causes of uncertainty. Specifically, it is difficult to predict how state and local governments will actually go about meeting the new regulatory requirement deadlines for attaining the national ozone standards. Further, the actual impact on state or federal budgets will in the end be a function of how the requirements are financed: polluters may pay many of these costs through fees and other charges, or the burden may be placed on general taxpayers.

MACROECONOMIC EFFECTS

The macroeconomic effects of environmental regulation are almost always presumed to be negative. Increased costs of production stemming from increased regulatory costs are assumed to lower output, raise prices, and lead to lower productivity. Part of the reason for this presumption is that discussion focuses on the industries that are hurt by environmental regulation and not on those that may benefit. The manner in which regulation is modeled (as a series of cost burdens for specific industries) limits the ability to consider benefits in the calculation. But the negative bias is also a function of how accurately long-term responses to increased compliance costs are approximated. If the economy is viewed as relatively inflexible with little opportunity for trade-offs between products and industries, macroeconomic effects are likely to be seen as large. An alternative view could produce significantly different results. Even the macroeconomic impacts themselves, however, cannot be taken as a final indicator of whether the country is better or worse off as a result of environmental regulation.

Illustrative estimates of potential macroeconomic impacts derived by the Congressional Budget Office (CBO) also find the economic effects of environmental regulations to be negative. (There are no existing formal analyses of the House or Senate proposals to amend the Clean Air Act.) But the CBO estimates and other research suggest lower impacts than might be expected on the basis of at least one recent macroeconomic study conducted on another environmental program. One dollar of pollution control expenditure lowers economic output by between one dollar and three dollars. While these results are partly determined by the structure of the model and by underlying assumptions, they show that the short-run, worst-case situation depicted by some existing estimates of simple compliance costs may be exaggerated.

Precise estimates of the economic consequences of environmental regulation are probably impossible to make. Measurement errors, data gaps, and other shortcomings limit the overall accuracy of any analysis. All economic models oversimplify reality and are subject to various biases. It is convenient to equate changes in economic variables such as output or prices with social welfare, but social welfare is a composite of the goods and services people value. Some of these can be measured, while others lie outside the economic model.

CHAPTER I

COSTS OF ENVIRONMENTAL REGULATION:

AN OVERVIEW

Environmental pollution poses a problem for the economy; absent corrective policies, polluters--whether the owners of factories or the operators of motor vehicles--have little incentive to stop polluting because the costs are borne by others while the polluters themselves profit. As long as the costs created by pollution remain "external" to the polluter, society effectively subsidizes polluters and their activities. If regulation reflects the extent of these external costs, it can lead all economic actors to incorporate the true costs and consequences of their activities into their economic decision making and, therefore, improve the well-being that society derives from its resources.

Even if regulators correctly assess the potential damage caused by pollution and dictate compliance and enforcement procedures that minimize disruptive effects, regulation will still require significant economic adjustments. Regulation ultimately will raise the prices of goods associated with pollution (relative to those that are more environmentally benign) and by so doing will change the composition of goods and services demanded by households and firms. Production of goods and services that lead to pollution will contract, and with it employment and affluence in some communities or regions. At the same time, production of substitutable goods and services, and of goods and services used in abating pollution, will increase.

Indeed, any major regulatory initiative, by influencing so many different goods, production sites, individuals, and economic decisions, cannot help but have broadly cast and important economic effects. Some of these effects will be local and some national; some will be immediately translated into measurable wealth or income changes (such as employment gained or lost) and some may never be "monetized" or captured directly in conventional economic measures. And what are perceived as economic losses to some will be experienced as important benefits to others. Thus, regulation may improve society's overall well-being (as measured by its subjective appraisal of its own welfare) while still lowering such purely material measures as gross national product.

The inherent complexity of the economy's response to regulation suggests the difficulty of finding a single answer to the question "what does a particular set of environmental regulations cost?" Possible answers could range from a very large amount (if every economic adjustment induced by a regulation were regarded as a cost and any associated benefit disregarded) to a very small or even negative amount (that is, if net rather than gross costs were considered and if regulation led, on balance, to increases in social welfare). Thus, while an analysis of the gross social costs of environmental regulation (focusing only on the negative economic adjustments) would show society worse off, a net social cost study (where positive adjustments are also included) might show

strikingly different results. As the Congress has been considering environmental legislation, many analysts have presented it with different estimates and analyses of economic costs that vary across this range. This paper, using current proposals to address the problem of ozone control, attempts to explain the strengths and weaknesses of different perspectives on cost and how these perspectives relate to each other.1/ It then evaluates some existing estimates of ozone attainment and considers different types of cost impacts of these estimates.2/

PERSPECTIVES ON THE COST OF REGULATION

Four definitions of "costs" are often used in analyses of environmental regulations. The definitions are not mutually exclusive--in fact, they may be thought of as being sequentially more inclusive, with each definition subsuming the effects incorporated into the previous one. The four definitions are: **compliance costs**, or estimates of the expenditures on equipment and services needed to comply with a given regulation; **industry-level costs**, which include compliance costs for an industry and may also include the value of an industry's lost output, revenues, or profits when these are relevant; **macroeconomic costs**, or the change in real economic activity that results from regulation; and **changes in social welfare**, or the value of the change in people's perceptions of their welfare after the compliance costs of a regulation have worked their way through the economy. Each of these is addressed in turn in the following discussion.

Compliance Costs

Firms responding to regulation must often purchase, operate, and maintain new equipment or must substitute materials or other production inputs. Typically, engineering studies of **compliance costs** attempt to estimate these expenditures on a plant-by-plant or industry-specific level before regulations are implemented.

Such studies generally superimpose a pollution-abating "end-of-pipe" technology over a prototypical plant or production technology. The cost of this equipment and its maintenance is treated generally as a pure addition to the cost of production (save for those instances where effluent recovery may lead to a usable by-product). These studies will often multiply the expenditure estimates for the prototypical plant by the number of such plants it would take to produce the relevant industry's current output. This procedure gives a useful approximation of the immediate cost effect of a regulation on an industry.

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1. The potential benefits of ozone attainment proposals are discussed more fully in Office of Technology, *Urban Ozone and the Clean Air Act: Problems and Proposals for Change* (April 1988).

2. This chapter deals with private-sector costs. Chapter III addresses corresponding public-sector costs.

Such engineering studies may overstate or misstate compliance costs for several reasons. First, technological advances allow firms to comply with regulations at lower cost in the long term. Firms may also be able to shift their productive inputs so as to minimize their expenditures or cost burden. Moreover, as new plants replace old ones in an industry, environmental concerns will be incorporated into their design, further lowering the cost of emission reductions. Thus, the "state of the art" that engineering studies seek to apply will change. Second, not all firms in an industry face the same costs when complying with a regulation: smaller firms may be exempted, larger firms may enjoy lower costs associated with larger size, and site-specific factors will always influence costs. Whether this influence leads to overestimates or underestimates of total industry costs depends on the sample chosen for the prototype and on the industry in question. Finally, not all firms comply with regulations, and the assumption that they all will leads to higher estimates of costs. A study performed in 1980 confirmed all of these tendencies, noting that engineering estimates of both the industry and the Environmental Protection Agency tended to overstate the actual costs of complying with various regulations.3/

Further, these studies implicitly assume that complying with environmental regulations will not reduce the output of an industry (since the costs of the "prototypical" plant are extrapolated to the industry's existing level of output). They also ignore how these compliance costs might be distributed between an industry's producers and the consumers of its product as prices adjust to the new costs. Such economic adjustments are not addressed in engineering cost studies.

An alternative basis for estimating past compliance costs for an industry involves the use of surveys that ask firms to report their actual compliance costs. This technique may lead to other kinds of misestimation. First, the respondents to these surveys are often unsure as to whether the expenditures they incurred were a response to federal or to state and local regulations. This "choice of a baseline" issue has grown more serious over time as state and local governments have added to federal regulatory requirements. Second, many production sites may not segregate the expenditures incurred in complying with regulations from other expenditures, and therefore their responses may at best be educated guesswork. Finally, it may be difficult to distinguish between environmental and other expenditures over time, both because effluent abatement strategies may shift from the installation of "end-of-pipe" equipment to incorporating abatement features into plant design, and because expenditures to maintain pollution-abating equipment are often indistinguishable from those that maintain other equipment.

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3. See Putnam, Hayes, and Bartlett, "Comparisons of Estimated and Actual Pollution Control Capital Expenditures for Selected Industries," Cambridge, Mass., 1980.

It is not surprising, then, that different surveys of compliance costs regularly produce widely disparate results.4/ Much the same is true of more aggregative measures, such as total private non-farm pollution control expenditures, although these vary by somewhat less than do industry-level data.5/

Industry-Level Costs

While compliance costs are generally depicted as borne by individual firms in specific industries, industry-level costs also include the cost of economic dislocations associated with regulation.

Regulation may have a variety of effects on an industry beyond compliance expenditures. For example, some firms may find it more cost-effective to reduce their output than to reduce the pollution associated with that output. In cases where no cost-effective technique for responding to regulation can be found (although this is rare), some older plants may close entirely. And if firms attempt to pass the cost burden of regulation forward to consumers, the quantity demanded of their product may fall, lowering output and perhaps profits. Alternatively, foreign competition may limit the ability of firms in an industry to pass these costs through. All of these effects pose costs to an industry of a different sort than the simple costs of compliance activities.

It is fairly common in studies of regulatory compliance costs to be presented with analyses of industry-level costs and impacts that derive from two main sources. The more formal assessments will be obtained from quantitative financial models on a firm-level basis that relate empirically additional pollution control expenditures to various measures of financial performance such as discounted cash flow. Plant-level financial analyses are then aggregated to the industry level to determine the impact on performance variables such as prices, profits, growth, or employment. Properly conducted, these analyses should give explicit consideration to demand and supply factors that define the ability of specific firms to pass cost increases forward or backward. Alternatively, industry-specific cost estimates are sometimes shown as a percentage or fraction of various indicators that are assumed to indicate the relative ability of an industry to absorb the initial cost burden or to show the impact of the additional expenditures on industry performance.

The more formal modeling approaches seem more likely to provide some insight into potential economic responses to an increased cost burden--to the extent that the industry has been appropriately modeled. On the other hand, the formal techniques are costly and require complex, plant-specific modeling.

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4. See P. Portney, "The Macroeconomic Impacts of Federal Environmental Regulation," in H.M. Peskin, P. Portney, and A.V. Kneese, eds., *Environmental Regulation and the U.S. Economy* (Baltimore: Johns Hopkins University Press, 1981).

5. See Congressional Budget Office, *Environmental Regulation and Economic Efficiency* (March 1985), pp. 55-56.

The other approach reveals much less concerning the ultimate impact of costs. The statement that the direct costs of a particular regulation or legislative proposal would be equivalent to X percent of total industry sales or net revenues is almost impossible to interpret. It may help to highlight specific industries that bear a relatively large cost burden. It may also be useful in understanding how the impact of costs varies for firms of different size within an industry.6/

A variety of studies have been performed through the years that chronicle the expected effects of regulation on an individual industry or on a cross-section of all industries.7/ These studies, while often valid, tend to concentrate on those industries that face the most onerous burdens under a proposed regulation, and therefore may overstate net costs if other industries benefit from the regulation. While such studies address an industry's gross costs, they do not inform as to society's net costs. For example, studies of air pollution regulations have characteristically linked them to the electric utility or ferrous and nonferrous metals industries; studies of water quality may look at the chemical and paper industries; studies of toxic and hazardous waste may focus on the chemical industry as may studies of hazardous air emissions. These studies are of obvious value in that they describe the set of firms (and, therefore, of workers or regions) that would be most dramatically affected by a regulation, but they present a one-sided view of the costs to society. On the other hand, industry-level cost studies such as these can serve to illustrate another important characteristic of industry cost burdens. Cost burdens rarely fall equally on all firms within an industry. For example, acid rain control legislation is likely to impose substantially higher costs on aluminum smelters that use coal-fired electricity than on smelters that use hydropower electricity. Even within an industry there will be winners and losers from environmental legislation.8/

Moreover, some industries will benefit from environmental regulation--industries that use environmental resources as inputs (such as agriculture, forestry, fisheries, or tourism) and industries that manufacture the inputs needed to comply with regulations (such as instrumentation). If regulation results in reduced health care costs or property damage costs, it may also expand the

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6. For example, EPA analyzes small business impacts by estimating the percent of production costs of small businesses associated with the additional costs of a regulation. Compliance costs over 10 percent of total production costs are considered a significant impact.

7. See L.B. Parker and A. Holt, *Acid Rain Legislation and Mid-Western Industries: A Mountain or a Mole Hill?* Congressional Research Service Report, June 6, 1985; Congressional Budget Office, *The Clean Air Act, The Electric Utilities, and the Coal Market* (April 1982); Robert W. Crandall, *Controlling Industrial Pollution: The Economics and Politics of Clean Air*, (Washington, D.C.: The Brookings Institution, 1983); W. B. Gray, "The Cost of Regulation: OSHA, EPA, and the Productivity Slowdown," *American Economic Review*, vol.77 no.5 (December 1987), pp. 998-1006.

8. See Parker and Holt in *Acid Rain Legislation and Mid-Western Industries: A Mountain or a Mole Hill?* for other examples.

demand for other goods and services or reduce their production costs. Neither of these effects is taken account of in the industry-level approach. Studies of industry-level costs, therefore, unless presented within a larger framework of regulatory costs and benefits, tell us more about the need for adjustment programs within the industry than they do about the final "cost" of a regulation or its desirability.

Macroeconomic Costs

Regulation may also change the levels of income, employment, and final prices for the whole economy. When the many production and consumption decisions resulting from the initial compliance costs are summed and their interactions taken account of, they may lead to changes in such macroeconomic variables as real output (measured by gross national product), the price level, and employment. While industry-level costs are "gross" costs (for a given industry), macroeconomic costs generally represent the "net" material cost of a regulation to society, over the long run.

A more neutral term would be macroeconomic "effects," since macroeconomic "costs" presumes that a regulation's depressing effects on economic activity will outweigh its output-enhancing effects and its net effect will be negative. There is some basis for this presumption, however, since some of regulation's benefits do not enter the calculation of GNP. Any analysis that deals only with measurable economic costs and benefits will neglect these effects.

But even measurable benefits may be undervalued in macroeconomic models, which--like the models of specific industries discussed above--are more sensitive to the cost burden associated with a regulation than to its benefits. This is a bigger problem at the macroeconomic level than at the industry level, where omitting benefits may not always bias the result. Proposals to lower air emissions, for example, must of necessity place a significant burden on the electric utility, automobile, metals, and petroleum refining industries. And even if they also generate economic cost savings, not all of the savings will be experienced by those industries. Treating regulation as a "cost burden" problem, therefore, may sometimes be appropriate when investigating specific industries.

But if the macroeconomic effects of regulation are estimated by representing regulation solely as a set of higher production costs, the biases found in industry studies will be compounded. This is the way regulation has generally been modeled.9/ It reflects the difficulty of identifying the dispersed and sometimes intangible benefits of regulation. One attempt to incorporate these benefits was made by Data Resources, Inc., which took all industry expenditures for operating and maintaining pollution-abating equipment and divided them by the average wage in manufacturing to reflect the employment generated by pollution-abating activities. (Doing so led to higher estimates for

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9. For a survey of macroeconomic studies of environmental regulation, see Congressional Budget Office, *Environmental Regulation and Economic Efficiency* (1985), pp. 59-75.

employment, output, and inflation, and lower estimates of productivity growth, as would be expected when employment is directly increased but measured output is not.)10/

Changes in Social Welfare

The ultimate measure of the cost of environmental regulation would be one that included the subjective value to consumers of goods and services forgone as a result of regulation. It would also include subjective losses through delay or inconvenience should regulation force people to change their living patterns. Such a measure would go beyond the macroeconomic costs and measure changes in social welfare.

The welfare measure is theoretically the most satisfactory since it would include all of the conceivable benefits of regulation. Its very breadth makes it the most difficult to apply. The ideal procedure for measuring changes in personal welfare is that of "compensating variation." This procedure identifies the amount of money that a person would require after a regulation is imposed in order to be subjectively "as well off" as before (or, in the case of benefits, the amount that a person would be willing to surrender). This would be the amount by which that person's welfare had changed. By summing individual responses, a social compensating variation can be obtained. This is the dollar value of the change in society's perception of its own well-being because of a regulation, and is probably the best theoretical measure of the ultimate "cost" of the regulation. A number of studies have used compensating variation techniques to assess such unmonetizable environmental benefits as the value of increased longevity, or the preservation of scenic vistas.11/

The difficulties of estimating this measure are obvious. Individuals may not report their perceptions accurately, and they may not have correct perceptions of the changes resulting from regulation. Moreover, some regulations have such wide-ranging effects that it is impossible to present people with a complete list of them. Efforts to use this technique to measure the costs of regulation must, therefore, employ a shorthand approach.

The first and foremost study to devise such a shorthand did so by calculating the payment needed to compensate society for the estimated losses in

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10. See Data Resources, Inc., "The Macroeconomic Impact of Federal Pollution Control Programs, 1978 Assessment," submitted to the Environmental Protection Agency and the Council on Environmental Quality, January 29, 1979.

11. See, for example, M. Cropper and F. Sussman, "Families and the Economic Risks to Life," *American Economic Review*, vol. 78, no. 1 (March 1988), pp. 255-260; or, for a broader perspective, A.J. Kneese, *Measuring the Benefits of Clean Air and Water* (Washington, D.C.: Resources for the Future, 1984).

output resulting from environmental regulation.12/ This provided a more sophisticated estimate of the cost of regulation. The authors note, however, that their estimates of the "cost" of environmental regulation must be balanced against estimates of benefits (in other words, they have estimated gross but not net costs). But for as pervasive a policy as environmental regulation, it is not clear that "costs" and "benefits" can be separated into distinct groups. Rather, regulation brings adjustments that are often costs to some and benefits to others.

As a practical matter, none of the cost-estimation approaches discussed here adequately captures this mixed character of most environmental regulation. Consequently, most of the methods tend to overestimate net economic costs. This is because the approaches rarely consider regulatory benefits, because benefits are difficult to measure, and because certain industrial responses to the cost burden of regulation--such as technological progress or input switching--may not be correctly anticipated.

OTHER COSTS

Much of the preceding discussion has been in terms of expenditures by firms or other industrial sources of pollution. These are by no means the only costs. Although industrial control costs are often the largest component of overall regulatory costs, compliance may also require expenditures on the part of federal, state, and local governments and by the general public directly (as distinct from consumer costs resulting from price increases). Governmental expenditures are treated in this study as public costs and are discussed more fully in Chapter III. Like any other type of public expenditure, federal, state, or local spending on pollution control programs can be expected to have a stimulative short-term effect on the economy, but could result in adverse international trade effects or decreased domestic private savings. Given the relatively small level of public expenditures for pollution control programs, these effects are likely to be minimal and difficult to detect.

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12. See H. Hazilla and R. J. Kopp, *The Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis* (Washington, D.C.: Resources for the Future, 1986). The authors first estimated, using a family of over 600 mathematical "preference functions" that they constructed to represent society as a whole (as does any random sample), the level of social welfare derived from the bundle of goods and services that society would produce were there no environmental regulation. They then added the cost burdens resulting from regulation and observed the change in the level and composition of the production of all goods and services. Using their family of representative "preference functions," they then estimated the level of well-being derived from this "post-regulatory" bundle of goods and the minimum feasible cost of raising social well-being from the lower, "post-regulatory" level to the higher, "pre-regulatory" level. This minimum feasible cost is the compensating variation that defines the value of the loss in well-being associated with regulation.

Costs incurred directly by the general public are included as private costs, and many have been taken account of in the earlier discussion. One category of costs borne directly by the general public deserves special attention, however. Many environmental control programs require changes in the public's consumption patterns and other daily habits. For example, leaf burning is banned in many localities, and some cities have restricted automobile commuting because of air pollution problems. Requirements such as these impose what might be called "consumer inconvenience" costs to the extent that the general public would be willing to pay some positive amount to avoid the required changes. These are real costs and should directly enter the calculation of social welfare losses. On the other hand, they are extremely difficult to measure since they are not usually reflected in market prices. Like other types of costs, moreover, consumer inconvenience costs are not static over time, but are likely to change as consumer preferences change. It is conceivable that some inconvenience costs associated with pollution control programs would decrease over time as the general public adjusted to and became more comfortable with the restrictions.